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Masters

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(54) **METHOD OF HEATING THE CLOTHES LOAD IN A TUMBLING COMBINATION WASHER/DRYER**

(71) Applicant: **Whirlpool Corporation**, Benton Harbor, MI (US)

(72) Inventor: **Roy E. Masters**, Saint Joseph, MI (US)

(73) Assignee: **Whirlpool Corporation**, Benton Harbor, MI (US)

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D06F 37/04	(2006.01)
D06F 37/26	(2006.01)

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CPC D06F 25/00; D06F 37/26; D06F 39/04; D06F 58/02; D06F 58/26

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,992,322	B2	8/2011	Kim	
10,590,583	B2	3/2020	Kitayama	
10,590,588	B2	3/2020	Kim et al.	
2003/0089138	A1	5/2003	Kawamura et al.	
2005/0229646	A1 *	10/2005	Byun	D06F 25/00 68/19.2
2005/0229650	A1	10/2005	Kim et al.	
2006/0225468	A1 *	10/2006	Hong	D06F 25/00 68/19.2

(Continued)

FOREIGN PATENT DOCUMENTS

CN	104018318 A	9/2014
EP	0829569 A2	3/1998

(Continued)

OTHER PUBLICATIONS

European Search Report for EP21204858, dated Mar. 21, 2022 (85 Pages).

(Continued)

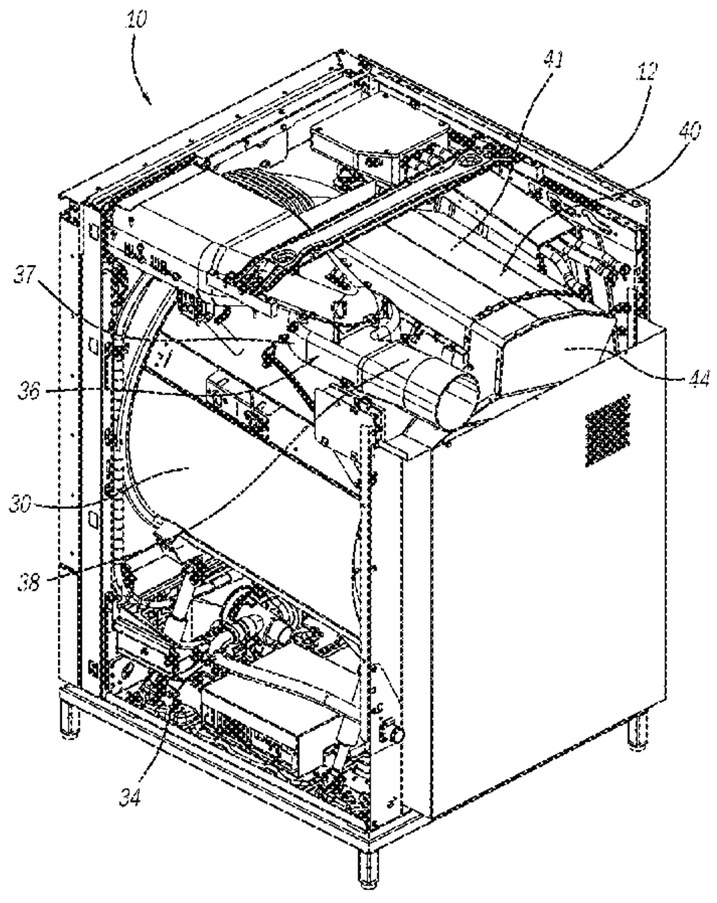
Primary Examiner — Joseph L. Perrin

(74) *Attorney, Agent, or Firm* — Harness, Dickey & Pierce, PLC

(57) **ABSTRACT**

A combination washer/dryer machine has a cabinet with a tub and drum positioned in the cabinet. The drum is rotatably positioned in the tub. A heater is secured to the tub. The heater includes a duct to provide heated air from the heater. The duct is coupled with the tub to supply heated air to the drum.

20 Claims, 4 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2008/0244922	A1*	10/2008	Kim	D06F 58/26 34/235
2012/0186305	A1	7/2012	Taniguchi et al.	
2012/0260520	A1	10/2012	Hong et al.	
2013/0198970	A1*	8/2013	Doh	D06F 25/00 8/137
2015/0191863	A1*	7/2015	Kim	D06F 58/20 34/493
2016/0168777	A1*	6/2016	Bison	D06F 58/206 62/238.7
2019/0338455	A1*	11/2019	Garnek	D06F 58/24
2020/0190726	A1*	6/2020	Jang	D06F 39/04

FOREIGN PATENT DOCUMENTS

EP	2206821	A1	7/2010
EP	2725131	A1	4/2014
EP	2894251	A2	7/2015
EP	3564429	A1	11/2019
JP	3920314	B2	5/2007
JP	4952727	B2	6/2012
WO	WO-89-02003	A1	3/1989
WO	WO-2004-104288	A1	12/2004
WO	WO-2014-181493	A1	11/2014
WO	WO-2018-123845	A1	7/2018

OTHER PUBLICATIONS

Final Office Action from the United States Patent and Trademark Office, dated Feb. 21, 2023, during the prosecution of U.S. Appl. No. 17/091,173 (12 pages).

* cited by examiner

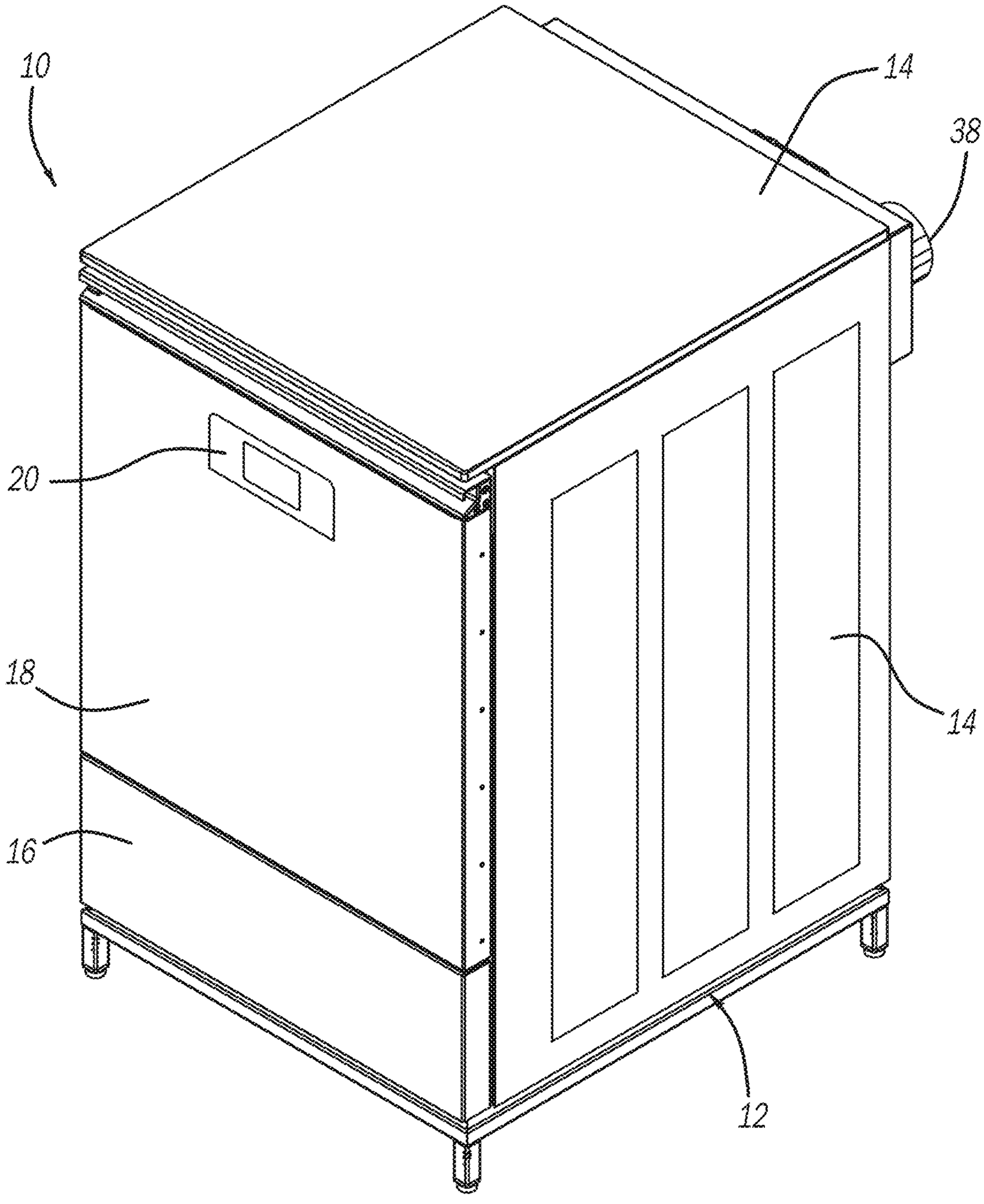


FIG - 1

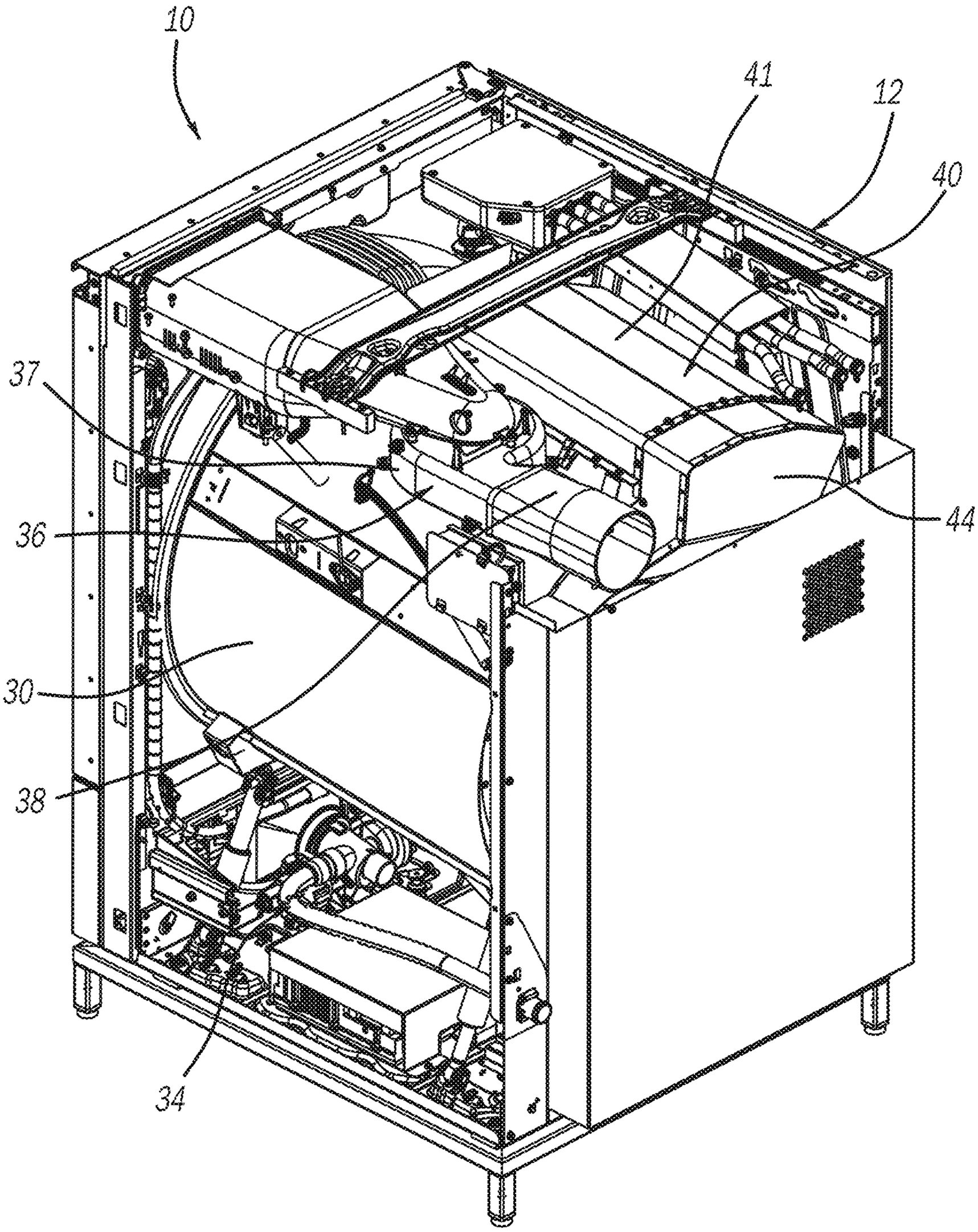


FIG - 2

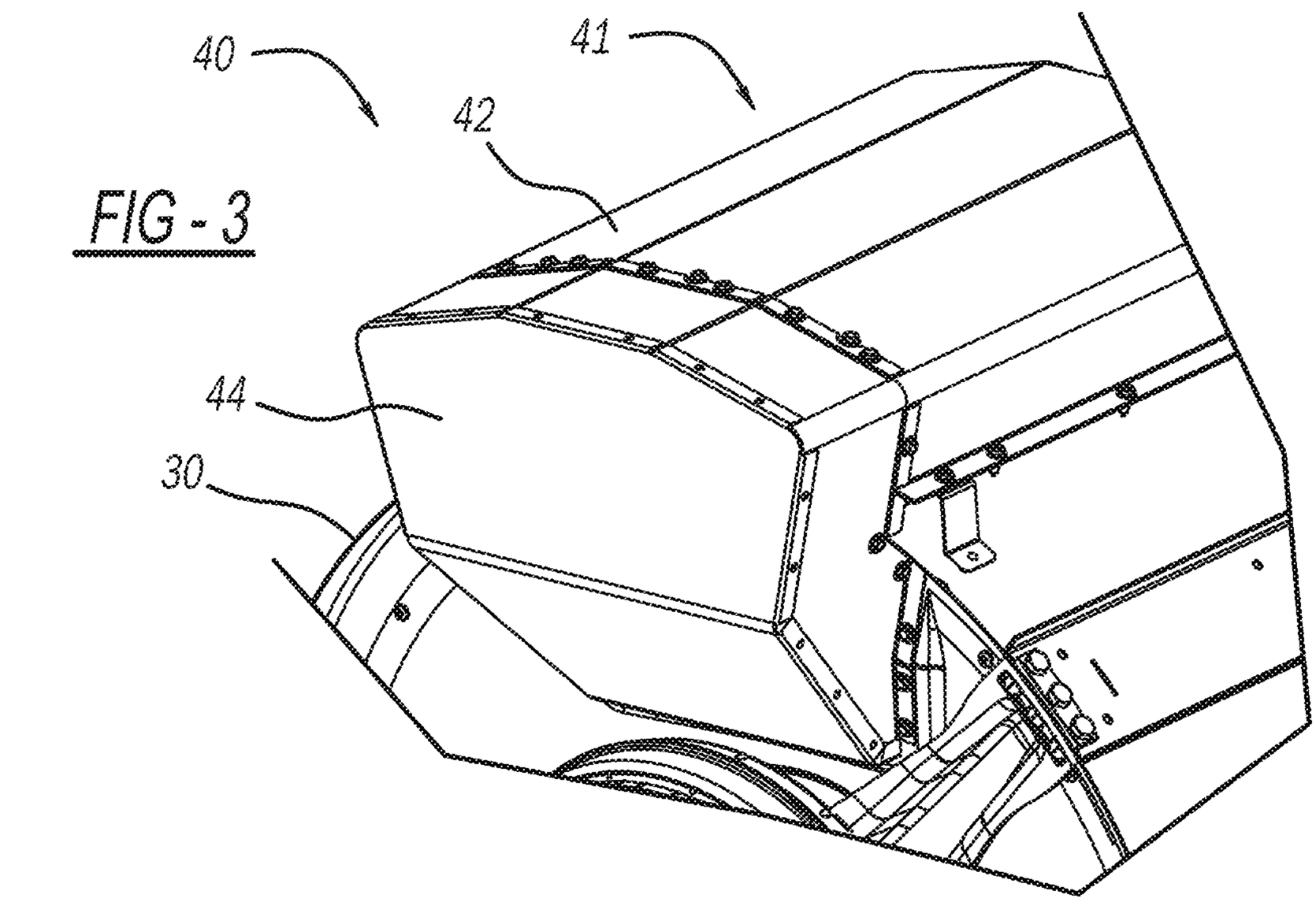


FIG - 3

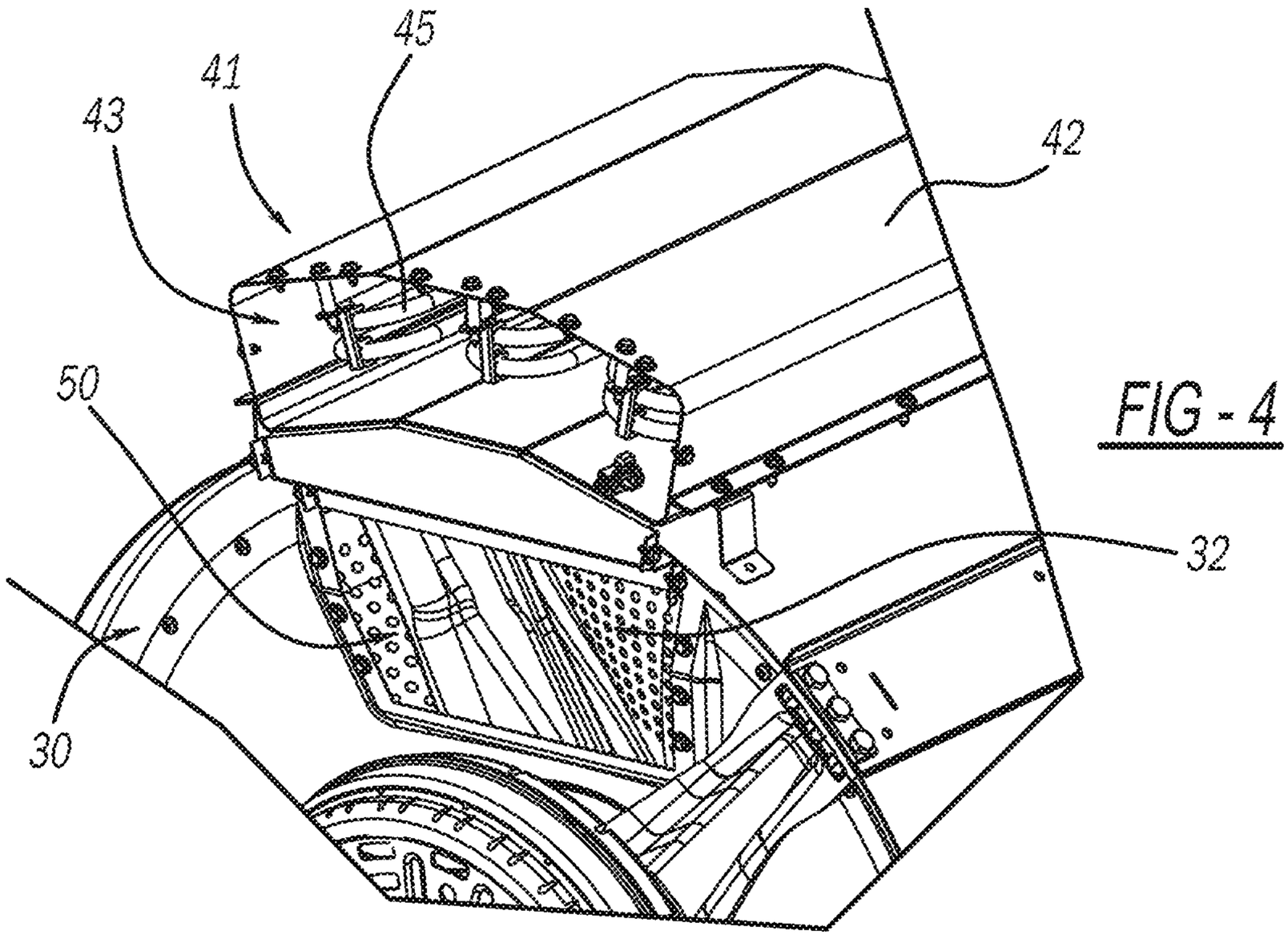


FIG - 4

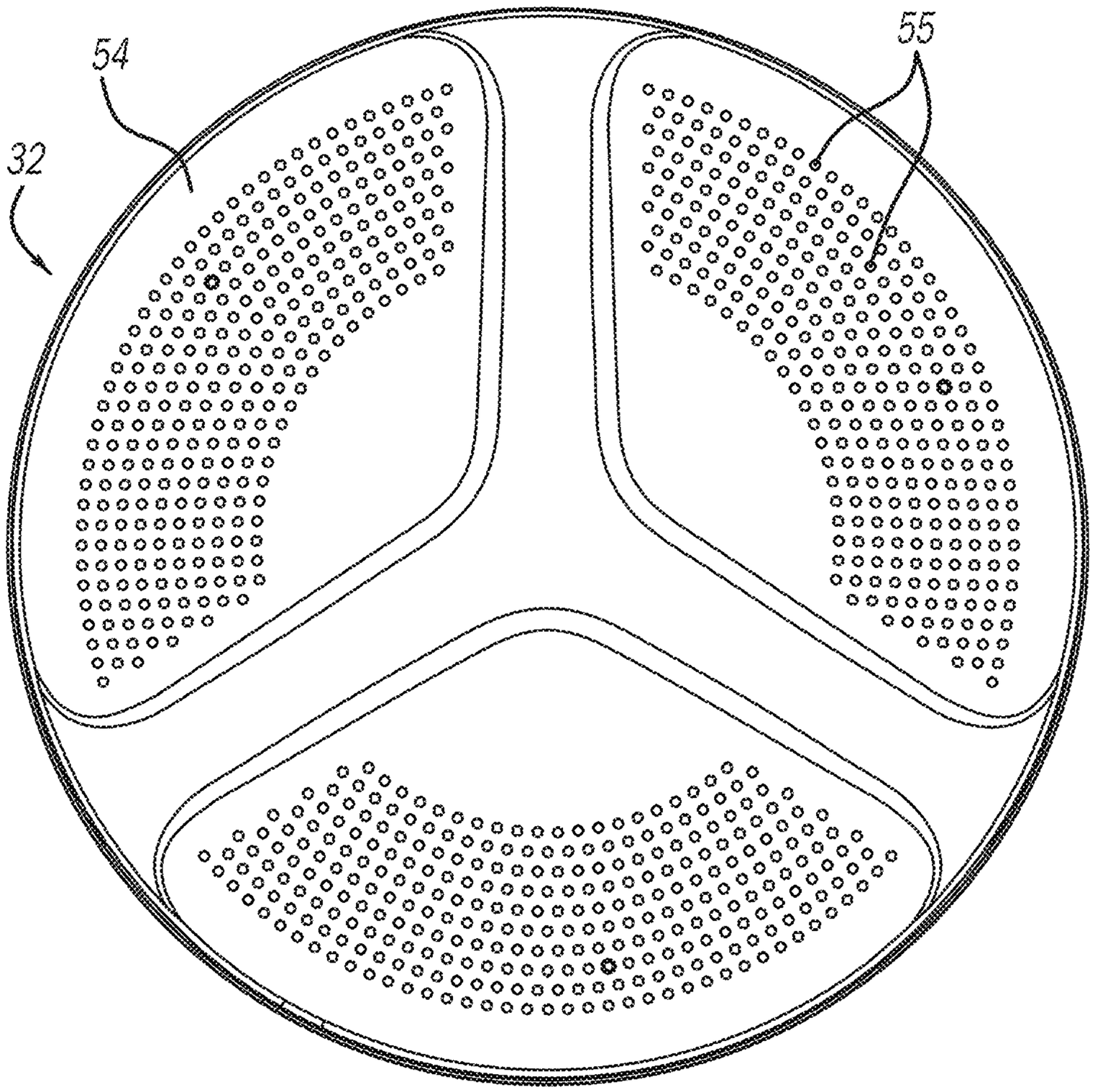


FIG - 5

METHOD OF HEATING THE CLOTHES LOAD IN A TUMBLING COMBINATION WASHER/DRYER

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 17/091,173, filed on Nov. 6, 2020. The entire disclosure of the above application is incorporated herein by reference.

FIELD

The present disclosure relates to a combination washer/dryer machine and, more particularly, to a heating circuit in the combination washer/dryer machine.

BACKGROUND

In prior combination washer/dryer machines, the drying cycle is long and inefficient. Due to closed drying systems in these combination washer/dryer machines, additional time is required to dry clothes within the drum. This is unlike a conventional dryer that is vented to ambient. Here, conventional dryers include a blower that draws air into the drum for quickly drying the clothes within the dryer.

Also, in current combination washer/dryer machines, there is tendency to have localized high temperature areas in the drum. This leads to the contact with the clothes within the dryer or components within the cabinet of the combination washer/dryer machine. This high temperature concentration contact may cause undesirable imperfection to the clothes or to the components within the cabinet of the washer/dryer machine.

Accordingly, it is desirable to provide heated air in a uniform manner into the drum. This avoids localized high temperature areas. Thus, this would improve drying.

Generally, the combination washers/dryers utilize ducts to provide hot air through a small port or small local grille inside the tumbling cavity. Thus, the temperature are generally higher. This is less desirable on a combination washer/dryer where the majority of components are polymeric in nature.

Accordingly, it is an object of the disclosure to overcome the deficiencies of the prior combination washer/dryer machines. It is an object of the disclosure to provide a heating circuit that generates uniform drying air. Thus, this eliminates a localized drying area. The present disclosure provides a rigidly mounted heater and duct end cap. This eliminates or avoids high temperature flexible duct work or piping. Additionally, the present disclosure provides a larger area in the tumbling cylinder for the distribution of the heated air through the clothes.

SUMMARY

In accordance with the present disclosure, a combination washer/dryer machine comprises a cabinet, a tub positioned in the cabinet and a drum rotatably positioned in the tub. A heater is secured to the tub. The heater includes a duct to provide heated air from the heater to the tub which, in turn, is distributed into the drum. The duct is likewise secured to the tub. The tub includes at least one opening to receive heated air from the duct. The drum includes apertures in its end surface providing at least 50 cm^2 of open area of the area of the end surface. The heater includes a metal housing to be secured to the tub. The heater duct is also metal. The duct can be an independent separate part from the heater.

According to a second embodiment of the disclosure, a combination washer/dryer machine comprises a cabinet, a door enabling access into the cabinet, and controls for operating the washer/dryer machine. A washing circuit and drying circuit wash and dry the clothes within the drum. A heater is secured to the tub. The heater includes a duct to provide heated air from the heater to the tub. The heated air is distributed into the drum. The duct is likewise secured to the tub. The tub includes at least one opening to receive heated air from the duct. The drum includes apertures in its end surface providing at least 50 cm^2 of open area of the end surface. The heater includes a metal housing secured to the tub. The heater duct is also metal. The duct can be an independent separate part from the heater.

According to a third aspect of the disclosure, a combination washer/dryer machine tub and drum comprises a tub and a drum inside of the tub. A heater is secured to the tub. The heater includes a duct to provide heated air from the heater to the tub. The heated air is distributed into the drum. The duct is likewise secured to the tub. The tub includes at least one opening to receive heated air from the duct. The drum includes apertures in its end surface providing at least 50 cm^2 of open area of the end surface. The heater includes a metal housing to be secured to the tub. The heater duct is also metal. The duct can be an independent or separate part from the heater.

Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

The drawings described herein are for illustrative purposes only of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

FIG. **1** is a perspective view of a combination washer/dryer machine in accordance with the disclosure.

FIG. **2** is a rear breakaway perspective view of the combination washer/dryer machine of FIG. **1**.

FIG. **3** is a breakaway perspective view of the washing machine of FIG. **1**.

FIG. **4** is a view like FIG. **3** with duct work removed.

FIG. **5** is an elevation view of the drum rear surface.

DETAILED DESCRIPTION

Example embodiments will now be described more fully with reference to the accompanying drawings.

Turning to the figures, a combination washer/dryer machine is illustrated and designated with the reference numeral **10**. The combination washer/dryer machine **10** includes a cabinet **12** with a plurality of panels **14**. The front panel **16** includes a door **18** to enable access into the cabinet **12**. A control panel **20** is located on the door **18** or front panel **16** of the cabinet **12**. The combination washer/dryer machine **10** includes a tub **30** with a drum **32** rotatably positioned inside of the tub **30**. A washing circuit **34** is illustrated coupled with the tub **30**. Additionally, a vented drying air circuit **36** with a blower **37** is illustrated coupled with the tub **30**. The blower **37** draws heated drying air though the drum **32** and then vents the drying air into the

ambient surroundings through desired exhaust duct work **38** of the vented drying air circuit **36**.

A heating circuit **40** includes a heater **41** that is positioned on the tub **30**. The heater **41** includes a heating element housing **42** that is secured, via fasteners, to the tub **30**. The heating element housing **42** includes an open end **43** and is generally a metal housing surrounding a calrod heating element **45** that is positioned within the heating element housing **42**. The heating circuit **40** also includes a duct end cap **44** that is coupled with the tub **30**. The duct end cap **44** enables the heated drying air to pass into the drum **32** through the tub **30**. The duct end cap **44** has a desired design and is generally manufactured from a metallic material. Also, the duct end cap **44** is secured to the tub **32**, via fasteners, to prohibit movement of the duct end cap **44** as well as the heating element housing **42**. The rigid mounting of the heating element housing **42** and duct end cap **44** to the tub **30** enables the design to avoid high temperature flexible duct. Also, this eliminates movement of the heating element housing **42** and duct end cap **44** caused by vibration.

The tub **30** includes an opening **50** to enable passage of the heated drying air into the drum **32**. The opening **50** may be a single large opening. Alternatively, a plurality of smaller openings may be present in a desired area to provide for structural integrity.

Additionally, the drum **32** includes an end portion **54**. The end portion **54** has a plurality of apertures **55** to enable the heated drying air to pass into the drum **32**. The apertures providing at least 50 cm^2 of open area in the end portion **54**. For example, the illustrated design provides 180 cm^2 of open area. Accordingly, this enables adequate heated airflow to travel through the apertures **55** and into the tumbling clothes for drying purposes. Thus, the open area of the apertures **55** provides for the desired airflow into the drum **30** to dry the clothes within the drum **30**.

In operation, drying is initiated. The control panel **20** initiates heating of the calrod heating element **45**. As this occurs, the blower **37** in the vented drying air circuit **36** is initiated. This blower **37** draws the heated drying air from the heating circuit **40** through the opening **50** in the tub **30**. After this, the heated drying air is drawn into the drum **32** via the apertures **55** in the end portion **54** of the drum **32**. The drying air then exits the drum **32** and flows into the tub **30**. The blower **37** then draws the drying air from the tub **30** and ultimately vents the drying air out of the cabinet **12** via the exhaust duct work **38**.

Thus, the heated air is drawn through the drum **32** to efficiently dry the clothes within the drum **32**. The drying time is thus substantially reduced.

The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

What is claimed is:

1. A combination washer/dryer machine, comprising:

a cabinet;

a tub positioned in the cabinet;

a drum rotatably positioned in the tub;

a vented drying air circuit coupled with the tub, the vented drying air circuit including a blower for drawing drying air through the drum and exhaust duct work for venting the drying air from the cabinet;

a heater secured to the tub, the heater including a heating element positioned within a heating element housing for heating the drying air; and

a duct end cap coupled with the tub for supplying the heated drying air from the heater to the tub,

wherein the heating element housing and the duct end cap form a heating circuit that is separate from the vented drying air circuit where the heated drying air from the heating circuit passes through the tub and the drum before entering the exhaust duct work of the vented drying air circuit.

2. The combination washer/dryer machine of claim **1**, wherein both the duct end cap and the heating element housing are rigidly mounted to the tub.

3. The combination washer/dryer machine of claim **1**, wherein the duct end ca extends over and covers an open end of the heating element housing and at least one opening of the tub.

4. The combination washer/dryer machine of claim **1**, wherein the drum includes apertures in an end portion of the drum that collectively provide at least 50 cm^2 of open area in the end portion of the drum.

5. The combination washer/dryer machine of claim **1**, wherein the heating element housing is metal.

6. The combination washer/dryer machine of claim **1**, wherein the duct end cap is metal.

7. The combination washer/dryer machine of claim **6**, wherein the duct end cap is an independent part separate from the heating element housing.

8. A combination washer/dryer machine, comprising:

a cabinet;

a door enabling access into the cabinet;

a washing circuit;

a tub positioned in the cabinet;

a drum rotatably positioned in the tub;

a vented d in air circuit coupled with the tub the vented dr in air circuit including a blower for drawing drying air through the drum and exhaust duct work for venting the drying air from the cabinet; and

a heating circuit that is separate from the vented drying air circuit, the heating circuit including a heater secured to the tub and a duct end cap coupled with the tub for directing heated drying air from the heater to the tub.

9. The combination washer/dryer machine of claim **8** wherein both the duct end cap and the heater are rigidly mounted to the tub.

10. The combination washer/dryer machine of claim **8**, wherein the tub includes at least one opening to receive heated air from the heater and the duct end cap extends over and covers both the at least one opening in the tub and an open end of the heater.

11. The combination washer/dryer machine of claim **8**, wherein the drum includes apertures in an end portion of the drum that collectively provide at least 50 cm^2 of open area in the end portion of the drum.

12. The combination washer/dryer machine of claim **8**, wherein the heater includes a metal heating element housing that is secured to the tub.

13. The combination washer/dryer machine of claim **8**, wherein the duct end cap is metal.

14. The combination washer/dryer machine of claim **13**, wherein the duct end cap is an independent part separate from the heater.

15. A combination washer/dryer machined, comprising:

a tub;

a drum rotatably positioned in the tub;

a vented drying air circuit coupled with the tub, the vented drying air circuit including a blower for drawing d in air through the drum and exhaust duct work for venting the drying air;

a heater that is separate from the vented drying air circuit and secured to the tub outside of the vented drying air circuit, the heater including a heating element positioned within a heating element housing for heating the drying air; and

a duct end cap coupled with the tub for supplying the heated drying air to the tub,

wherein the heating element housing and the duct end cap form a heating circuit that is separate from the vented drying air circuit.

16. The combination washer/dryer machine of claim **15**, wherein both the duct end cap and the heating element housing are rigidly mounted to the tub.

17. The combination washer/dryer machine of claim **15**, wherein the tub includes at least one opening to receive heated drying air from the heater and the duct end cap extends over and covers both the at least one opening in the tub and an open end of the heating element housing.

18. The combination washer/dryer machine of claim **15**, wherein the drum includes apertures in an end portion of the drum that collectively provide at least 50 cm^2 of open area in the end portion of the drum.

19. The combination washer/dryer machine drum and tub combination of claim **15**, wherein the heating element housing is metal.

20. The combination washer/dryer machine drum and tub combination of claim **19**, wherein the duct end cap is metal.

* * * * *